# H.A.R.S Journal

Journal of the Hereford Amateur Radio Society

Issue No 22 • April 2020




## Editorial

Hello Ladies & Gentlemen, I do hope you are all at ease with the lesser publishing routine of this JOURNAL. In truth the bi-monthly practice became too much for me. This one is in time for Easter however, and has articles that recognises the possible needs of the "beginners" such as those who have successfully passed the Foundation Licence Course No 8 at HARS.

Comment: Pretty Charlotte M7CJL, you won't have any problem finding people to talk to… good luck (Mike G3LZM ed.)

As just about everyone has heard, my friend, and everyone's friend, Bob G3IXZ, suffered a stroke at Christmas time last year. He was in hospital for several weeks and with this knowledge we were all anxious and concerned. In time for this Journal issue I telephoned Gwen, his YL, to see if he was making progress and to get permission to publish if indeed there was good news.

Well, there is! When Gwen passed the phone over to Bob we had a great conversation and although he spoke slightly differently, I could follow his every word – well done Bob! He does not require a pushchair but has to keep using a stick a while longer. We are all mightily relieved and our thanks and thoughts go out to Gwen for the wonderful skill she is using looking after G3IXZ… see you soon Bob.

**STOP PRESS…**

Unfortunately Bob is back in hospital!

Whilst attending the "flicks" at the village hall on Friday 13th he fell and broke his femur and he is scheduled for an early operation with his hip being the focus of attention.

Gwen reports that Bob is comfortable. Poor Gwen – she didn't arrive back home from the hospital until the early daylight hours. Our hearts go out to you Gwen… Thanks.

*Mike (Ed)*

## Funny Hats Night


*Dave Butler G4ASR*

*Nigel Hancocks G4XTF (Chairman)*

*Duncan James M0OTG (Hon Sec)*

*Adey G8IVO and Wendy*

# Spotless sun about to set record

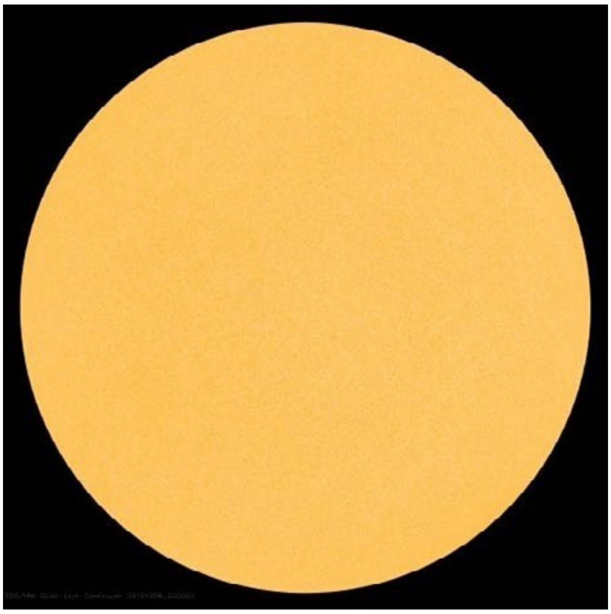
Right: The blank sun on Dec. 8, 2019.
Credit: NASA/Solar Dynamics Observatory
(Source: SpaceWeather.com via Michael Bird)

ONE WEEK FROM A SPACE AGE RECORD: 2019 is about to set a Space Age record. So far this year, the sun has been blank (no sunspots) for 261 days, including the last 24 days in a row. If the streak continues for only 7 more days, 2019 will break the Space Age record for spotless suns.

The previous record-holder is the year 2008, when the sun was blank for 268 out of 365 days, making the Solar Minimum of 2008-2009 the deepest of the Space Age. Next weekend, barring a sudden profusion of sunspots, 2019 will move into first place.

Solar Minimum is a normal part of the -year sunspot cycle. The past two (2008-2009 and 2018-2019) have been long and deep, making them "century-class" Minima. To find a year with more blank suns, you have to go back to 1913, which had 311 spotless days.

What are the side-effects of Solar Minimum? On one hand, solar flares and geomagnetic storms subside, making it harder to catch Northern Lights at mid-latitudes. Space weather grows "quiet." On the other hand, cosmic rays intensify. The sun's weakening magnetic field allows more particles from deep space into the solar system, boosting radiation levels in Earth's atmosphere. Indeed, this is happening right now with cosmic rays nearing a Space Age record.



*Thoughts on "Spotless sun about to set record"*

**Edward December 9, 2019 at 8:18 pm**

Just as the Parker solar probe collects significant data on the sun. Maybe they can send a nother probe to arrive at a sunspot maximum.

**Mario December 9, 2019 at 6:15 pm**

Just set up a QRP station for CW, SSB, guess it's gonna' be a challenge, hi hi. Even WWV sounds weak these days. Time to listen on the lower bands, e.g., AM BCB and longwave for some excitement.

**Thomas *post author* December 9, 2019 at 8:21 pm**

I've done some pretty impressive QRP DX during this "spotless" period. Don't let the sun stop you!

But you're right: these are also great conditions for the lower bands!

Cheers, Thomas

*Mike (Ed.)*

# Foundation Licence Course No 18 at HARS

Following a successful weekend training Foundation Licence course over February 8th and 9th the HARS Training Team are pleased to announce that all eight passed and have applied for (and most have received) their new Foundation M7 callsigns.

This course was a joint production with the Malvern Hills Radio Amateurs Club in that two of their members attended for the training and their Chairman Dave Hobro G4IDF again was part of the Training Team.

Geoff's G8BPN QTH and HARS Clubrooms was the location and much use was made of his shack for the practical elements.

The HARS Training Team were Phil G4HQB, Rich G4FAD, Ben M0SWV, Geoff G8BPN, Josh M0WYP, Adey G8IVO, Tony M0VDO, Duncan, M0OTG and Dave G4OYX.

The candidates were (L - R): Stephen M7BTF, Andrew M7XAM, Hayden [call TBC], Simon M7GTI, Halisi M7ISI, Chris M7EMP, Charlotte M7CJL, Jon M7EMI

If you are interested in attending a Training Course please click on the website training button and send an email.

*Dave Porter G4OYX,*
*Training Co-ordinator HARS.*

## For Sale

HP 8657B 2GHz RF Generator

Advantest R3271 100MHz - 26.5GHz Spectrum Analyser

If interested, contact
Mike (Ed) 01432 272987

Small Desk

Small Table

# George Laurer, amateur radio operator and inventor of the Bar Code, dies at 94

Many thanks to SWLing Post contributor, Paul Evans, who writes:

George Laurer (K4HZE), the inventor of the Bar Code (that's on everything you buy) died recently: https://www.bbc.com/news/world-us-canada-50726950

I happened to meet him and fellow IBM 'pusher' of the idea (Norman Woodland) when they were visiting Bermuda. Ed Kelly (VP9GE) invited them to give a presentation to the RSB (Radio Society of Bermuda) meeting at the Elbow Beach resort in November 1975.

It turns out they were promoting the idea to local supermarkets because Bermuda was an isolated test subject that would be ideal for a limited roll-out. We couldn't understand why they would stick a label with bars on it onto every thing and then scan it! It just wasn't going to take off…. or so we thought!

Well, it never took off in Bermuda. Today 'Marketplace' (formerly Piggly Wiggly) still sticks price labels on every item and there is no bar code scanning. It must be one of the last places to do so in the First World!

It's interesting how they were both hams and that the idea was based on Morse code. It's a small world.

I had no idea…his legacy will certainly live on. There's hardly an item on the planet that doesn't have a barcode these days. Many thanks for sharing this memory with us, Paul.

*4 thoughts on "George Laurer, amateur radio operator and inventor of the Bar Code, dies at 94"*

**DanH December 14, 2019 at 1:29 pm**

KarTrak was an ancestor of UPC (Universal Product Code). This barcode was used by several US railroad companies to code freight cars beginning in the early 1960's. Like UPC, KarTrak made use of bars that were decoded by a laser scanner. The bars were made of reflective and colored tape. Unlike UPC, KarTrak used color coding instead of bars of differing widths. Railroads abandoned KarTrak in the late 1970's. There was no practical way to keep the reflective barcodes clean from grime and graffiti that collected on US freight cars. https://tedium.co/2017/09/05/kartrak-railroad-barcode-history/

Morse code was used for telegraphy for some fifty years before it was adapted to radiotelegraphy.

**Mark December 14, 2019 at 1:21 pm**

The 'humble' bar code is mentioned in the book 'Fifty Things that Made the Modern Economy' by Tim Harford, an interesting read of many seemingly mundane things we take for granted, but which have had a huge impact.

> **Jim Tedford December 15, 2019 at 6:16 pm**
>
> "Fifty Things That Made The Modern Economy" is a great book. BBC World Service has a podcast based on it. One of the episodes is on the bar code: https://www.bbc.co.uk/programmes/p04k0066

**Michael Black December 14, 2019 at 10:49 am**

In the early days of "Byte" magazine, there were articles about back codes. And somewhere among the material was a comment about a similarity to morse code, I guess because the bars were both narrow and wide. The comment provided some insight about barcode decoding, but seeing that this guy was a ham, I wonder if it was deliberate. Maybe the design derived from Morse code to some extent. One would have to dig out the articles and see exactly what was said.

# M.E.P. SMD Rework Station

*By Nigel Hancocks, Club Chairman*

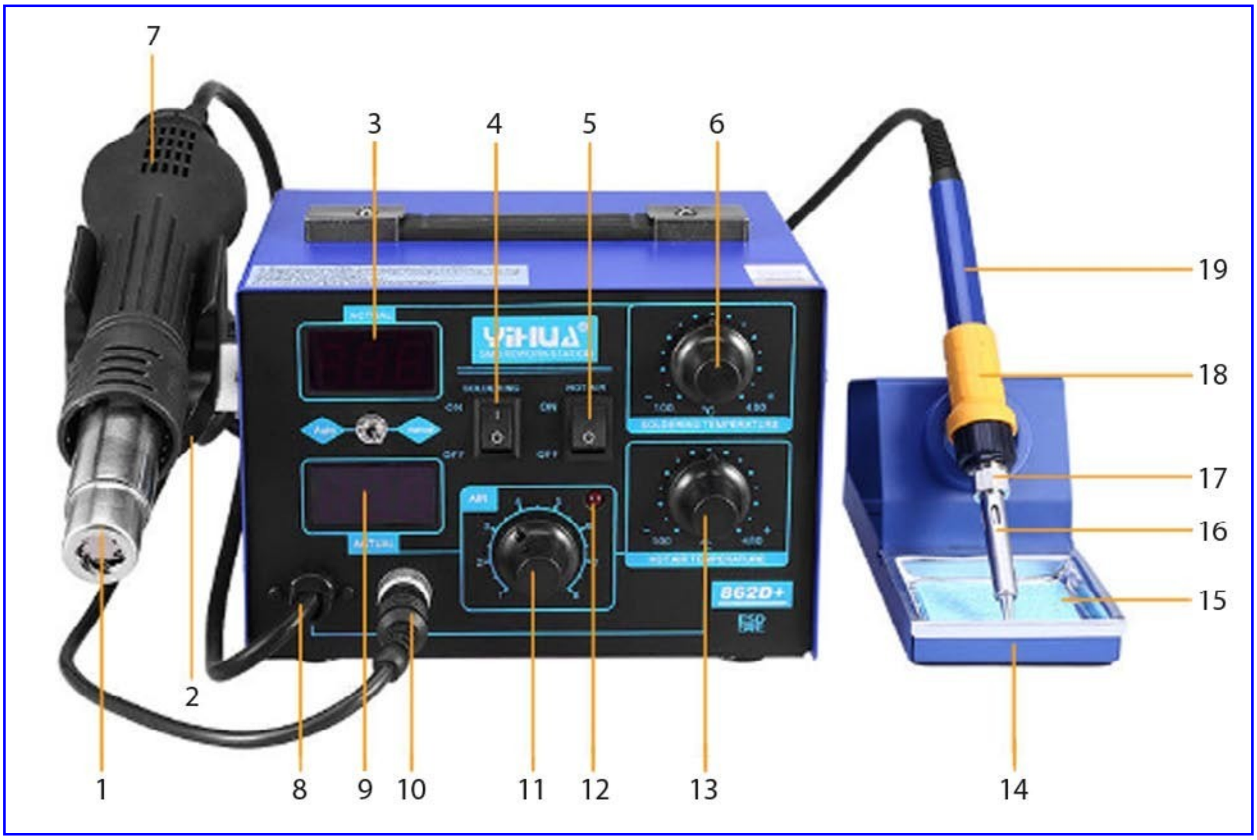
This soldering station was purchased through Ebay so that I could have a go at doing some SMD (surface mount device) soldering. Similar “badged” units to that shown above, are available for about £53. The following are my observations about using the iron and hot air gun.

The soldering station came well packed in a large brown box, bubble wrapped and in its own box. The contents were individually wrapped in polythene bags and needed attaching to the main station.

Curiously, the main on/off switch was mounted inconveniently on the back of the soldering station and was therefore out of sight and difficult to locate. Also as the hot air gun is mounted on the left-hand side of the station near to the main switch, it could be a possible accident waiting to happen, especially if, like me, you are left handed.

The instructions were not very clear and the numbered photograph (shown above) omitted to indicate that the auto/manual switch for the hot air gun was positioned between the two led temperature screens; the top screen was for the soldering iron and the lower one for the hot air gun.

The auto/manual switch that controls the hot air gun was not properly explained in the operating instructions and it was only while trying the hot air gun that I discovered its function. I found that if switched to ‘auto’ the




1 Hot air nozzle
2 Hot air gun support and magnetic switch activator
3 Solder iron set/ actual temperature led screen
4 Solder iron switch
5 Hot air gun switch
6 Solder iron temperature setting control
7 Hot air gun handle containing magnetic switch
8 Hot air gun cable
9 Hot air gun set/ actual temperature led screen
10 Solder iron plug and socket
11 Hot air velocity control
12 LED indicating Hot air fan running
13 Hot air gun temperature setting control
14 Solder iron stand
15 Spongepad
16 Solder iron replaceable tip
17 Tip nut
18 Silicon rubber grip
19 Solder iron

heating element was turned off when the gun is placed in its cradle; but if it was switched to 'manual' the gun continued to blow hot air even when it was in the cradle. I can see a possible danger if the hot air gun was in its support because the continued flow of hot air could cause a fire. Obviously it is important to position the solder station very carefully away from combustible material.

I have mainly used the soldering iron while building the QCX Labs qrp rig and I found that it was very useful to be able to set the working temperature. However, I discovered that the tip was rather large for closely spaced components. Also, it appeared to become "contaminated" rather quickly which made it difficult to solder good joints. This could be an operator's problem through using too high a temperature or due to a reaction between the solder and the tip material. However, this did not stop me from completing the QCX successfully. I also had these problems while constructing a cheap oscilloscope that had both SMD and through-hole components, a project that was not completed with 00% success as I found that there were a number of dry joints.

I have not used the hot air gun to solder many SMD components. The few that I have tried have been successfully installed but I found the connecting wire and the bulk of the hot air gun awkward to handle and direct at small components.

In conclusion, the problems I had with this Solder Station were more likely user based and further practice will see them reduced. The Solder Station is well made and good value for money. Providing you use the usual common sense about working with hot apparatus and are aware of the possible design faults I have noted, you will have a very useful bit of kit at a very reasonable price.

*Thanks, Nigel… Ed.*

## HARS radio equipment available for loan to Club members or for purchase

The following list of equipment is available for loan to Club members. The loan period is 3 months and members wishing to use the equipment will have to sign a simple agreement which covers the loan terms. If you wish to borrow then please contact Duncan (Hon Sec) M0OTG.

- Grid Dip Meter MFJ-201
- Buddipole 0-40M portable antenna with tripod and carrying case.
- Yaesu FT450 All bands to 50MHz. Needs a 2V PSU
- Pixie 7MHz QRP kit. Needs assembling.
- Baofeng UV-5R 70cms/144MHz hand-held complete with accessories.

*Go portable with the Buddipole! …Ed.*

# Why Do Resistors Have A Color Code?

*by Al Williams, January 13, 2020*

One of the first things you learn in electronics is how to identify a resistor's value. Through-hole resistors have color codes, and that's generally where beginners begin. But why are they marked like this? Like red stop signs and yellow lines down the middle of the road, it just seems like it has always been that way when, in fact, it hasn't.

Before the 1920s, components were marked any old way the manufacturer felt like marking them. Then in 1924, 50 radio manufacturers in Chicago formed a trade group. The idea was to share patents among the members. Almost immediately the name changed from "Associated Radio Manufacturers" to the "Radio Manufacturer's Association" or RMA. There would be several more name changes over the years until finally, it became the EIA or the Electronic Industries Alliance. The EIA doesn't actually exist anymore. It exploded into several specific divisions, but that's another story.

This is the tale of how color bands made their way onto every through-hole resistor from every manufacturer in the world.

## Dots Then Bands

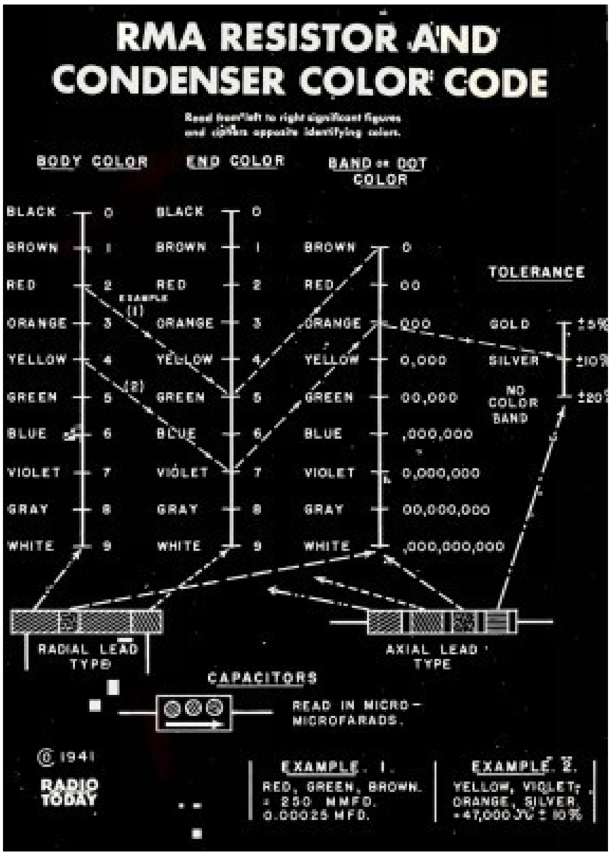
Ésistances anciennes annees 50 by François Collard, CC-BY-SA 4.0

By the late 1920s, the RMA was setting standards and one of them was the RMA standard for color-coding. The problem was that marking small components is difficult, especially back in the 1920s.

The solution was color bands, but not quite as we know them today. The standard for colors was the same, but the body of the resistor acted as the first band. Then there would be two or three other bands to show the rest of the value. In some cases, the third band was actually a dot. So the bulk of the resistor would be the first band color. The "tip" of the resistor would be the 2nd band and a dot would be the multiplier. Radios using this scheme started to appear in 1930. Here's the color code chart from the 1941 Radio Today yearbook:

Ads in that magazine promoting resistors were careful to note that they were RMA color-coded. The code soon extended to capacitors (condensers, in the contemporary parlance).

The dot, as with printed piece of text on the cylindrical, might be hidden from view depending on the position of the resistor. So eventually, everyone switched to bands.




The colors are meant to follow the visible spectrum (remember ROY G BIV?). However, the RMA omitted indigo because apparently many people don't distinguish blue, indigo, and violet as three different colors; indigo is really a tertiary color, anyway and Newton included it because of his interest in the occult, apparently. That leaves four slots, so dark colors represent the low end (black and brown) and bright colors the high end (gray and white).

Of course, none of this was funny if you were color blind. Reading a resistor with a meter or a bridge out of the circuit was certainly an answer. Reading one in a circuit, though, was another matter.

### The Origin of E-Series Values

In 1952 the International Electrotechnical Commission (IEC, another standards group) defined the E-series which dictates what values resistors come in so that you get equal spacing on a log scale for resistors. If that sounds confusing, consider an example.

The E2 series is for 0% resistors and the values on it give you 2 values per decade. The base values are

**1, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2**

That's why you can get, say a 4.7 K or 47 K resistor but not a 40K resistor.

However, consider the tolerance. A 10% 39 K resistor could be off by 3.9 K. If the error pushed the resistance up that would be 42.9K, making a 40 K resistor unnecessary. That is, a 39 K resistor might well be a 40 K resistor, anyway. A low 47K resistor, on the other hand, could be 42.3 K, which is less than a high-value 39 K unit.

As you might expect, the number of values goes up as the tolerance goes down. At 2%, for example, you'll use E48 which has 48 values per decade (if you'd guess E96 — the standard used for 1% has 96 values, you'd be right). Using E48, the values near 40 K are 38.3 K and 40.2 K. That's 39.06 on the high side and 39.2 on the low side.

### Next Time

Next time you pick up a resistor and read the code from it, you can recall the history behind it all. The legacy of color bands carries over into the surface mount realm, not as color but as three digits representing the first two numbers and multiplier for the resistor's value. These days many electronics like wireless modules and lithium batteries include a datamatrix (something like a QR code) on them. Honestly, I'm surprised that all components — through hole and surface


mount — don't have some form of micro data matrix on it that lets you point your phone at them and see their complete datasheet. Maybe one day.

There are 219 thoughts on this Hackaday column "Why Do Resistors Have A Color Code?", some of which are well worth a read. https://hackaday.com/2020/01/13/why-do-resistors-have-a-color-code/

# Powerful radio signal from deep in space is repeating in a 'pattern', say scientists

**Mysterious pattern could be an important clue to the origin of mysterious blasts**

*by Andrew Griffin @_andrew_griffin*
*Monday 10 February 2020 10:21*

A mysterious radio signal coming from deep in space appears to be repeating in a pattern, say scientists.

The powerful blast is coming from somewhere unknown and extragalactic, and is perhaps the most unusual "fast radio burst" ever detected by scientists.

Researchers have already spotted a number of the fast radio bursts originating from deep in space. They have even seen that limited numbers of them appear to repeat.

But the new breakthrough, spotted by scientists using a telescope in Canada and described in an early paper published online, is the first time that researchers have seen the blasts appearing in a regular, predictable pattern.

Astronomers have no confirmed explanation for the FRBs, with the only certain fact about their origin that they must be coming from somewhere very extreme and unusual. Proposed explanations have included everything from alien civilisations sending us messages to a star falling into a black hole, but the fact that the messages are repeating have led some scientists to lead out such cataclysmic causes.

The FRBs are in a 16-day cycle that sees them appear and then go dark, before doing the same all over again. Over the course of the cycle, the bursts will appear intensely for a four day flurry that sees a signal come every hour or more, and then it will go quiet for 2 days.

That pattern is "an important clue to the nature of this object", the researchers write in the new paper.

**Are aliens sending us messages from light years away?**

It appears to be coming from the edge of a massive spiral galaxy, about 500 million light years away, the researchers say. But there are few other clues about where it could be coming from or the processes that may have given rise to it.

The fact that it is repeating over a predictable period could suggest that it is coming from a binary system, since other objects in space that demonstrate similar characteristics tend to be binary systems, too. The object could be being swung around by a star or black hole, and the periodic blasts could be an indication that the object is facing us during those times, the researchers say.

It could also be possible that winds or tidal disruptions from the black hole block the signal during the periods it is silent, they note.

The repeating signals were spotted by the Canadian Hydrogen Intensity Mapping Experiment, which spends time looking for more FRBs in an attempt to find their origin. It should spend more time looking at the source of the current bursts – known as FRB 180916.J0158+65 – in an attempt to learn more about it, the researchers conclude in their paper, which is for now published on the website ArXiv before being peer reviewed and published in a journal.

*A Radio signal sent out every 16 days from a planet in space an always the same, is now with experts trying to translate it. It must they say have been sent by Aliens.*

*Well it has been translated by experts at the radio & computer section in Bletchley Park and what it says is as follows.*

*"This is my frequency and also the clubs as well as RAYNET'S. I have your callsign an I will report you to the RSGB who will track you down and I have you on my beam as well. I have been on this frequency for 85 years now so it must be mine."*

*They think it may simply be an echo as it is often heard in English on 145.200 MHz.*

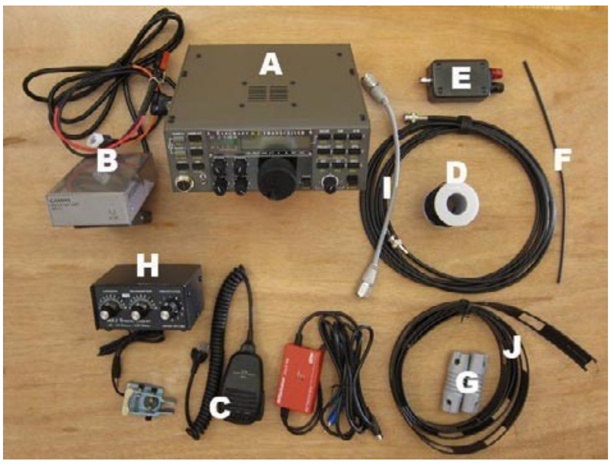
# Five Ham Radio Projects with Diana Eng

From 2009-2010, Make: had the pleasure of hosting a series of ham radio articles by fashion designer, hardware hacker, and ham radio enthusiast, Diana Eng. You may also remember Diana from season 2 of Project Runway. Besides writing ham radio how-tos, she also wrote about the ham scene in general, high-tech fashion, and even how to make a Bluetooth-based Star Trek Communicator. Here are five of Diana's best radio project posts. Some of the technology may have changed in the past several years, but the amateur radio world doesn't move nearly as fast as the computers, so these pieces are still relevant to today's budding ham.

The individual projects are available from links in the original article at [https://makezine.com/2015/11/06/5-ham-radio-projects-with-diana-eng/](https://makezine.com/2015/11/06/5-ham-radio-projects-with-diana-eng/)

### Setting Up a Home Ham Radio Shack

Diana runs through the basics of how to set up a traditional high frequency (HF) amateur radio station at home.




### Making a Collapsible Fabric Yagi Antenna

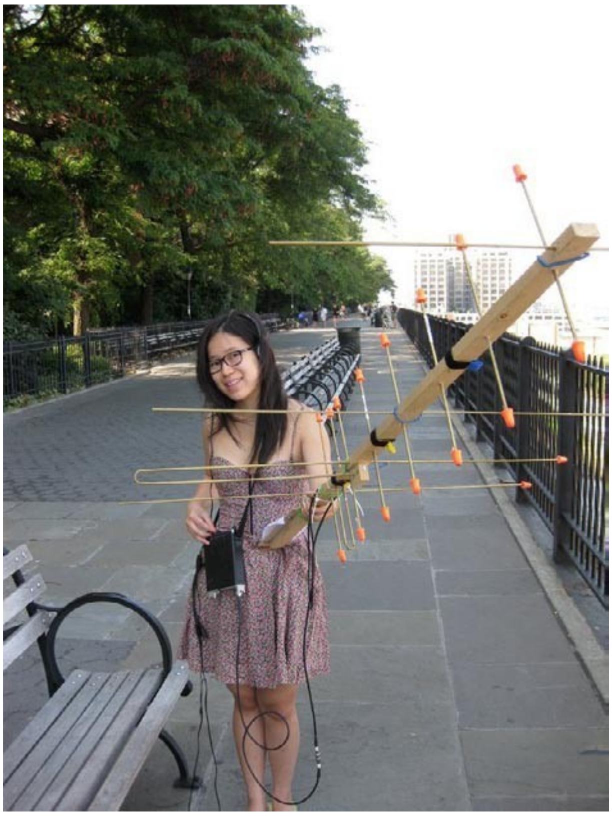
Communicate with satellites in space with this portable Yagi antenna. In this project, Diana shows you how to basically sew a Yagi-type antenna into a roll-up nylon canvas satchel that you can carry to any listening post.

### Setting Up an HF Portable Radio While Hiking

Carry a complete radio shack on your back with this tutorial on how to get hammy on a hike.

### How to Catch a Satellite

Diana writes: "My favorite ham activity is making contacts via satellites. Not only is there the romantic notion of sending messages into outer space, but you have to trace the orbit of the satellite with your antenna while tuning the radio, to compensate for the Doppler effect."



**Making a Multiband EFHWA for Amateur Ham Radio**

Diana shows you how to make your own End-Fed Half-Wavelength Antenna (EFHWA) for portable ham operations.

You can see all of Diana Eng's articles for Make: on her author bio page at [https://makezine.com/2015/11/06/5-ham-radio-projects-with-diana-eng/](https://makezine.com/2015/11/06/5-ham-radio-projects-with-diana-eng/)

# The HARS Technical Library

This is the new lending library thanks to Bob G3IXZ, who is the "owner". The library is of course at Hill House - thanks to Geoff G8BPN. Great stuff here…, do take a look.


Subjects covered include: Antennas, Technical, Reference, Historical, Equipment and QRP.

# Articles Wanted!

Please think about submissions/projects you might like to send in or see.

General topics and key words are listed below.

| | | |
|---|---|---|
| Members projects | Events | Training |
| Members station | Notices | QRP/QRO |
| Construction | Help | Illustrations |
| Items wanted | News | Photographs |
| Items for sale | DX | Early radio |
| Hints and kinks | Militaria | Restoration... |

... or anything else that you think might be of interest to HARS members. If you have an idea for a submission, but don't know how to present it, I will do it for you.

Please submit anything and everything to journaleditor@herefordradioclub.uk or talk with Mike at the Club meetings.

*73s es GDX, G3LZM*
*Mike Bush (Editor)*

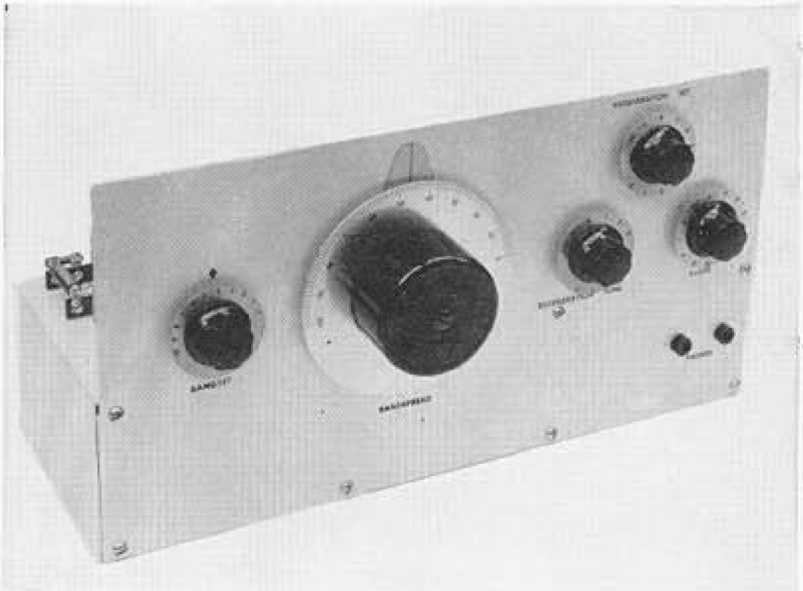


Fig. 1—Three-transistor regenerative receiver covering 1.65 to 30 Mc. Six self-contained 1.5-volt flashlight cells power it, with a current drain of less than 3 ma. The bandspread tuning dial is a Jackson Brothers type 4489.

# A Three-Transistor Receiver

## *The FET as a Regenerative Detector*

BY WALTER F. LANGE,* W1YDS

EVEN in this age of crowded bands and sophisticated communications systems, there is room for the lowly regenerative receiver. The unit shown in Figs. 1 through 6 is a simple receiver that should be easy for most anyone to build, regardless of his experience. Plug-in coils are employed, eliminating the complexities of wiring a band switch. No test equipment is required, as nothing needs to be aligned; once the unit is constructed, it should work without any difficulty.

Self-contained flashlight cells are used, making the receiver immune to power blackouts. Since the supply voltage is only 9 volts, there is no shock hazard for the beginner to worry about. Being battery operated and entirely transistorized, the receiver has no power transformers or filaments to heat up and cause drift.

The receiver is more useful than a superhet for checking intruders that are supposedly in the ham bands, as the three-transistor unit has no converter stages to generate spurious signals that may give a false indication of the frequency of an incoming signal. Coverage of 160 meters is provided, a feature left out of many higher-priced commercial receivers. Sensitivity of the receiver is such that a.m., c.w. and s.s.b. signals of 0.1 $\mu$v. or greater are audible in the headset. All-in-all, the receiver does a surprisingly good job for the small amount of circuitry involved. It doesn't have the selectivity or signal handling capability of a good superhet, but after all, you usually get what you pay for.

Referring to Fig. 2, the components between points A and B form a filter to attenuate broadcast-band signals. This filter greatly reduces the chances of front end overload by nearby broadcast stations. In locations where there are no powerful broadcast signals, the filter may be left out. Points A and B should then be connected together.

A field-effect transistor (FET), which has high input impedance, is used as the regenerative detector, $Q_1$. With suitable circuit modifications a conventional n-p-n transistor will work, but its low input impedance will load down the tuned circuit, resulting in some loss of selectivity, and the detector will tend to overload easier. The FET detector uses the Colpitts circuit, doing away with the need for winding a tickler coil or tapping the main inductor. The detector is tuned by bandspread capacitor $C_5$ and band-set capacitor $C_6$. One amateur band occurs in the frequency range of each plug-in coil. In each case capacitor $C_4$, in series with the bandspread capacitor, has been chosen so that the amateur band in question occupies the entire tuning range of the bandspread capacitor.

Regeneration is controlled by varying the source bias of $Q_1$. Although only one regeneration control is normally found in regenerative receivers, two controls are provided here to make

*Although the superhet is by far the most popular receiver in use today, the regenerative receiver still has a place in the ham shack. Its simplicity makes it an ideal beginner's project as well as an easy-to-make standby unit for the advanced amateur.*

* Assistant Technical Editor, *QST*.

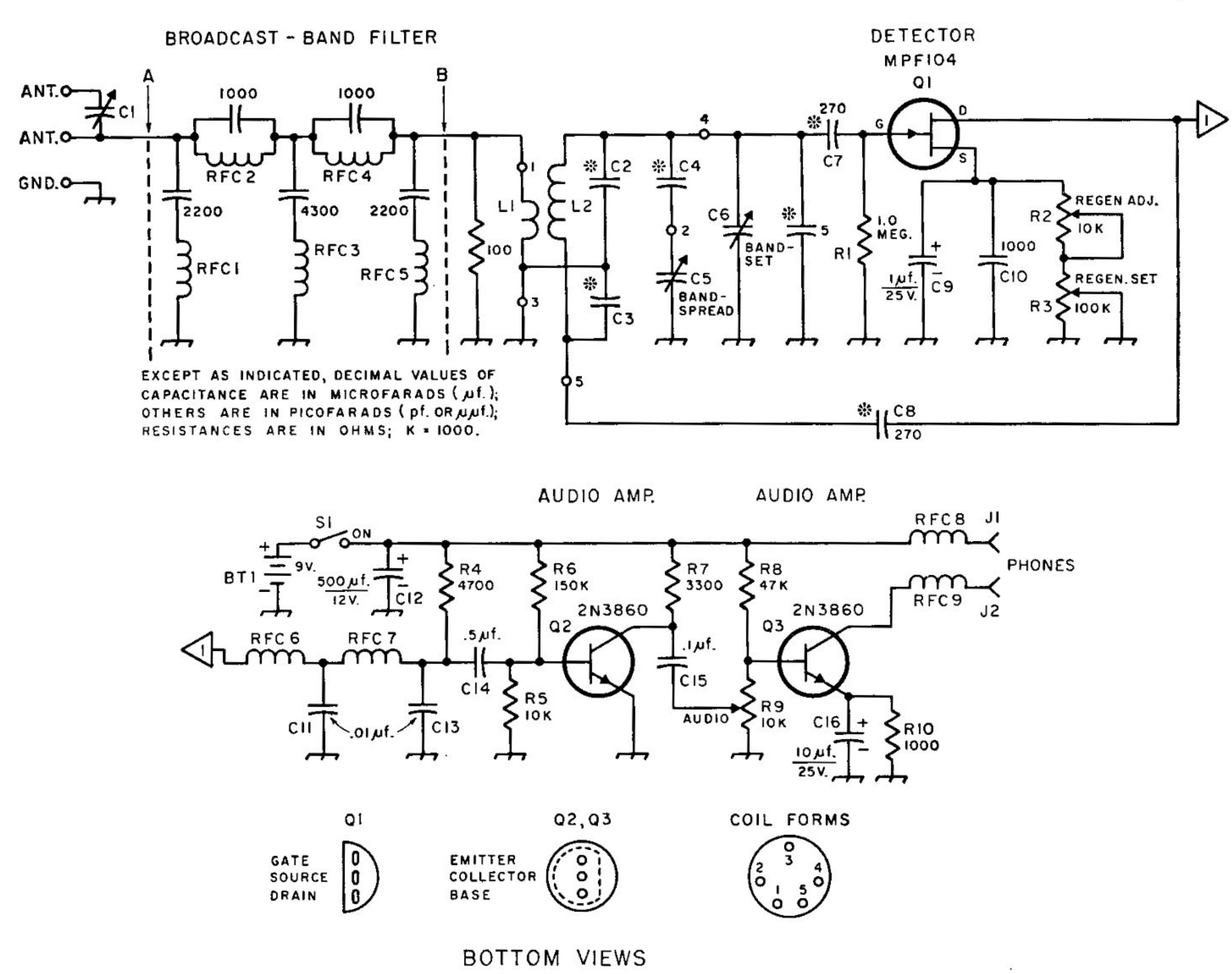



**Fig. 2—Circuit diagram of three-transistor regenerative receiver. Fixed resistors are ½-watt composition. Capacitors marked with polarity are electrolytic; those marked with an asterisk are dipped silver mica; other fixed capacitors are disk ceramic. Components not listed below are numbered for reference.**

$BT_1$—Six 1.5-volt flashlight cells (size D) in series.
$C_1$—9-180-pf. mica compression trimmer.
$C_2$, $C_3$, $C_4$—See Table I.
$C_5$—50-pf. variable (Millen 19050).
$C_6$—140-pf. variable (Millen 19140).
$J_1$, $J_2$—Insulated tip jacks.
$L_1$, $L_2$—See Table I.
$Q_1$—Field-effect transistor (Motorola MPF104).
$Q_2$, $Q_3$—N-p-n transistor (General Electric 2N3860, 2N2925, 2N3391A, 2N3403, or 2N3405).
$R_2$—10,000-ohm control, linear taper.
$R_3$—100,000-ohm control, linear taper.
$R_9$—10,000-ohm control, audio taper, with $S_1$ attached.
$RFC_1$, $RFC_5$—10 µh. (Millen 34300-10[1]).
$RFC_2$, $RFC_4$—33 µh. (Millen J300-33).
$RFC_3$—5 µh. (Millen 34300-5).
$RFC_6$, $RFC_7$—2.5 mh. (Millen 34300-2500).
$RFC_8$, $RFC_9$—68 µh. (Millen 34300-68).
$S_1$—S.p.s.t.

[1] James Millen Co. will sell direct if you cannot get the components from a distributor. Write to James Millen Co., Malden, Mass., Attn: Wade Cayewood.

adjustment easier. $R_3$ is for coarse adjustment and $R_2$, one-tenth the value of $R_3$, is for fine control. An electrolytic capacitor, $C_9$, bypasses both controls for audio; without it, the detector would be rather insensitive. $RFC_6$, $C_{11}$, $RFC_7$ and $C_{13}$, form an r.f. filter in the drain circuit of $Q_1$ to keep r.f. from reaching the base of the first audio amplifier, $Q_2$. A 4700-ohm resistor, $R_4$, is used as the detector load, rather than an expensive inductor or transformer. Volume control $R_9$ varies the amount of signal reaching the base of audio output stage $Q_3$. $Q_3$ should have a high-impedance headset (2000 ohms or more) as its collector load. The headset leads are kept from acting as antennas (creating hand-capacity effects on the higher bands) by being isolated from the power supply and $Q_3$ with r.f. chokes.

### *Construction*

The receiver layout is uncritical and you can vary it considerably to suit your own requirements. However, don't alter the detector circuit too much, if you expect it to have the same band coverage as listed in Table I. If you are a new-

**Table I**
**Coil and Capacitor Data**

Capacitors are dipped silver mica (values are in picofarads) mounted in the coil form close to the base of the form. Coils are close-wound with enameled or Nylclad copper wire on 1-inch diameter 5-pin coil forms (Millen 45005). For winding details see Fig. 3.

| Coil | *Range Mc.* | $C_2$ | $C_3$ | $C_4$ | $L_1$ *turns* | $L_2$ *turns* | *Wire Size* | *Dimensions, inches* A | B | C |
|---|---|---|---|---|---|---|---|---|---|---|
| I | 1.63–2.55 | 68 | 1800 | short | 4½ | 44¼ | No. 26 | ⅜ | ½ | 1 5/16 |
| II | 2.45–5.6 | — | 1300 | 68 | 3½ | 35¼ | No. 24 | 5/16 | 9/16 | 1⅜ |
| III | 4.90–10 | — | 680 | 22 | 2½ | 18¼ | No. 20 | 11/32 | 19/32 | 1¼ |
| IV | 9.70–18 | — | 220 | 12 | 2½ | 9¼ | No. 20 | 11/32 | 19/32 | 15/16 |
| V | 16–25.7 | — | 100 | 12 | 2½ | 6¼ | No. 20 | 11/32 | 19/32 | 13/16 |
| VI | 20–30 | — | 68 | 18 | 2½ | 5¼ | No. 20 | 11/32 | 19/32 | 23/32 |

comer to amateur radio, construct the receiver as shown in the photographs and become familiar with its operation. Once you have gained some experience, you will be in a better position to make changes, if you want to.

The receiver is built on a 13 × 5 × 3-inch aluminum chassis with a 13 × 7-inch aluminum plate serving as the front panel. If you don't have the tools to cut a piece of sheet aluminum to the specified size, a commercial bottom plate will serve nicely.

Referring to Fig. 4, center $C_6$'s tuning shaft 2 inches from the right edge of the panel, and center $C_5$'s tuning shaft 5½ inches from the same edge. Bolt the capacitors to both the panel and the chassis, being careful not to damage the plates at the front of the capacitors with mounting screws that may be too long. Attach two 1-inch ceramic pillars (Millen 31001) to a 5-contact tube socket (Amphenol 78RS5) and position this assembly half way between $C_5$ and $C_6$ so that pin 3 of the socket is closest to the front panel. Before bolting the pillars to the chassis, put a soldering lug (to be connected to pin 3) under the ceramic insulator nearest the front panel, and slide a flat washer under the other insulator. Space terminal strips $TB_1$ through $TB_4$ 2½ inches apart, with the first mounting

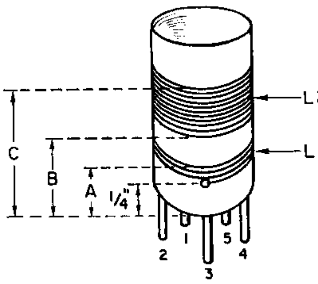



Fig. 3—Sketch of typical plug-in coil used in the regenerative receiver. $L_1$ and $L_2$ are wound in the same direction. The hole for each wire is drilled directly above the pin to which the wire is to be soldered. The bottom of $L_1$ goes to pin 3, the top of $L_1$ goes to pin 1, the bottom of $L_2$ goes to pin 5, and the top of $L_2$ goes to pin 4. For specific information on each coil see Table I.

hole 1 inch from the left edge of the chassis and ½ inch from the rear. Fasten these terminal strips and the battery holders to the chassis with the same screws.

Install $C_5$'s dial mechanism on the front panel using two ¾-inch 6-32 threaded spacers. Attach $C_6$'s dial so that it indicates 0 at maximum capacitance and 10 at minimum capacitance. All the dials except the one for $C_5$ are from Millen's 10005 series.

By close inspection of the photographs and the schematic diagram, it should be easy to wire the chassis. The circuit runs from left to right in the schematic and from approximately right to left in the rear view of the chassis. Using Fig. 6 as a guide, connect transistor sockets to the appropriate terminal strips. Solder the center lead of each socket directly to the terminal lug shown and use short lengths of wire between the remaining leads and lugs. Use a heat sink, such as an alligator clip, when soldering the last end of each wire to be secured, otherwise the lead may come undone from the first connection. Make all the remaining connections as short and direct as shown in the photographs.

Referring to Fig. 3 and Table I, begin constructing the coils by drilling four holes in each 5-prong form with a No. 50 drill. Each hole should be drilled above the prong to which the end of the coil will be terminated. Wind $L_1$ first and then $L_2$. Scrape the ends of the coils with a knife or razor blade, so that good electrical contact can be made to the prongs. It will be easier to get tight windings if the wire spools are held in a vise while the coils are being wound. Wind the coils at a distance from the vise, keeping the wire taut. After $L_1$ and $L_2$ have been put on the form, install $C_2$ (if applicable), $C_4$ or a short, and $C_3$ in that order. Push the capacitors down to the base of the coil form, keeping the connecting leads as short as possible. Carefully solder the coil prongs. Wipe away any rosin from the prongs with a cloth dipped in alcohol. To protect the coils, it may be desirable to spray them with clear lacquer or coat them with coil dope.

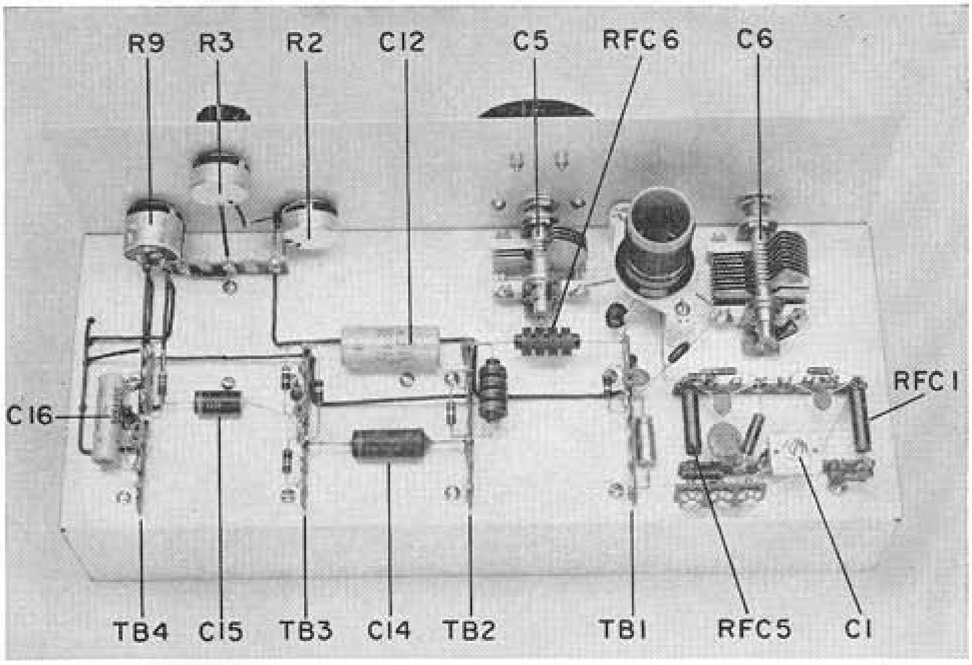



Fig. 4—Top view of the regenerative receiver. The two eight-lug terminal strips at the lower right support the components of a broadcast-band filter. Antenna and ground input terminals are located beside the filter at the edge of the chassis; the connector is a cut down screw-type terminal strip soldered to a standard lug-type tie-point. Of the four parallel terminal strips next to the filter, $TB_1$ and $TB_2$ support the regenerative detector, $Q_1$, $TB_3$ supports the first audio stage, $Q_2$, and $TB_4$ supports the output stage, $Q_3$.

Before turning the set on, check the wiring carefully with the schematic diagram and the photographs. Be especially careful that the batteries and transistors are installed correctly; note that the negative side of the supply is connected to the chassis.

### *Use*

The audio output stage works best with high-impedance headphones (connected to $J_1$ and $J_2$) although lower-impedance phones will work, at reduced output. To check out the receiver, connect an antenna to either antenna terminal and run a ground lead to the set. Plug coil II in the receiver and set the 0 to 10 band-set capacitor dial at 7.5. With $C_6$ at this setting, the bandspread capacitor should tune from approximately 3.5 to 4 Mc. Turn the audio gain control full on. With the fine regeneration control, $R_2$, at about midrange, advance the coarse regeneration control, $R_3$, until the receiver starts to oscillate. The point at which the detector begins to oscillate is easy to recognize, as a thumping sound is heard and the background noise increases. Then by tuning the bandspread capacitor it should be possible to hear signals.

It will be necessary to vary the regeneration controls for optimum reception of different signal types (a.m., c.w. and s.s.b.), strengths and frequencies. For a.m. reception, advance the regeneration controls to the point just before where the detector oscillates. This is the most sensitive operating point for a.m. signals, and the selectivity of the circuit is better than at lower settings of the regeneration controls. Very strong signals, which may cause "blocking," may be reduced by backing off either $R_2$ or $R_3$ or both or by reducing the antenna coupling by connecting the antenna to the receiver through $C_1$ and opening up the plates of the capacitor as much as required.

The most sensitive setting of the detector for code reception is with the regeneration controls advanced just beyond the point of oscillation. However, very strong signals may overload the detector and become impossible to tune in at low beat notes. This can be overcome by further advancing the regeneration controls or by reducing the antenna coupling as described above. Note that if the regeneration is pushed too far, a point may be reached where an audio squeal will be heard. For satisfactory operation of the receiver, be sure the regeneration controls are set below this point.

S.s.b. is tuned in with the regeneration controls set at the same point as for c.w. The bandspread capacitor should be tuned very slowly through

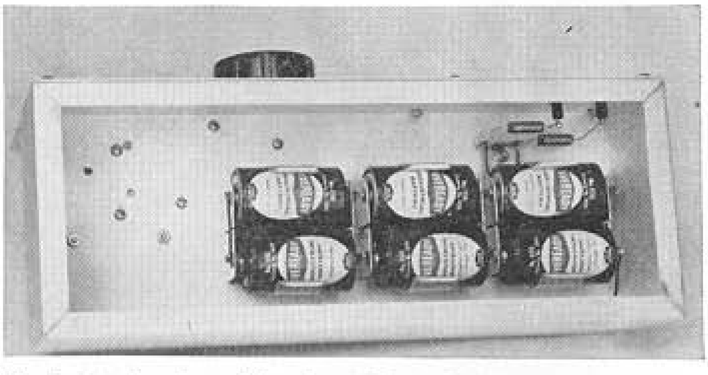


Fig. 5—Interior view of the chassis. Three double battery holders (Keystone type 176) support the receiver power supply. The two r.f. chokes at the upper right are $RFC_8$ and $RFC_9$.

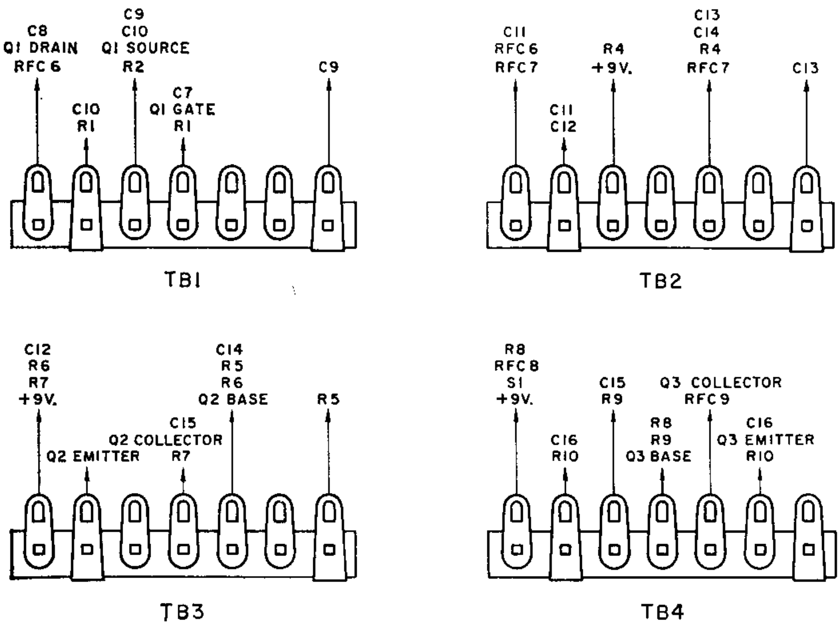



**Fig. 6—Connections to the four terminal strips, $TB_1$ through $TB_4$. The left edge of each terminal strip is closest to the front panel.**

the signal until the voice becomes intelligible. Overloading is conquered in the same manner as for code reception.

Best use of the two regeneration controls will be obtained by following this procedure: Set the band-set capacitor, $C_6$, for the desired band coverage. Turn $C_5$ and $R_2$ to midrange. Set $R_3$ at the point where the detector just starts to oscillate. Tune $C_5$ and adjust $R_2$ as required. In some cases the fine regeneration control may run out of range; it will then be necessary to readjust $R_3$ to bring it back in the ballpark.

Two undesirable effects may be noticed with this receiver, especially at the higher frequencies. If an inadequate ground system is used, the receiver will exhibit hand-capacitance effects. Also, as with any regenerative set, an antenna blowing in the wind can cause the frequency to change. If the latter difficulty becomes serious, an indoor antenna might be called for. Lighter antenna coupling and coaxial feed will also reduce the effects of antenna movement on the detector.

The bandspread system used in this receiver was set up with the amateur bands in mind. Other bands are spread out to a lesser or greater degree. Table II shows the approximate settings of the band-set capacitor, $C_6$, for spreading each high-frequency ham band over the tuning range of the bandspread tuning capacitor, $C_5$. How accurate each setting is, of course, depends on how closely the coils are duplicated.

### *Possible Modifications*

In order to keep costs down, no cabinet was used to house the receiver. The set should perform well in most locations without one. However, in some spots, a.c. pickup may be a problem. By using a metal cabinet, there won't be any need to worry about hum, and the set will look more attractive. A cabinet having a hinged cover is the most desirable, as it will facilitate coil changing.

If additional coverage is desired, more coils can be constructed. In order to cover the broadcast band, three plug-in coils will likely be required because of the small size of $C_6$. In addition, it will be necessary to disconnect the b.c. filter to prevent severe attenuation of the broadcast signals. It may be possible to tune the 6-meter band if an appropriate coil is constructed; however, performance will probably not be too satisfactory at v.h.f.

In order to achieve optimum $Q$ with easy-to-make closewound coils, three sizes of wire had to be used. However, if you don't mind the slightly more difficult job of space winding the coils, you can save yourself the cost of two spools of wire. Using the same dimensions and turns count given in Table I, wind coils II through VI with No. 26 wire, being careful to equally space the turns.

**Table II**

| *Coil* | *Band* | *$C_6$ Setting* |
|---|---|---|
| I | 160 | 4.5 |
| II | 80 | 7.5 |
| III | 40 | 7.5 |
| IV | 20 | 8.0 |
| V | 15 | 8.0 |
| VI | 10 | 9.5 |

If you are a Novice and want more bandspread for the Novice frequencies, use a smaller value of capacitance at $C_4$ than that listed in Table 1. Try a 10-pf. capacitor in coil II and 8-pf. capacitors (3- and 5-pf. units in parallel) in coils III and V. If this change is made, the setting of the band-set capacitor for the amateur band in question will be different than that listed in Table II.

Since the current drain of the receiver is less than 3 ma., just about any size of 9-volt battery can be used to power the set. However, the author prefers a bank of ordinary flashlight cells, as they are available at more stores than any other type, and will last a long, long time in this receiver. QST

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